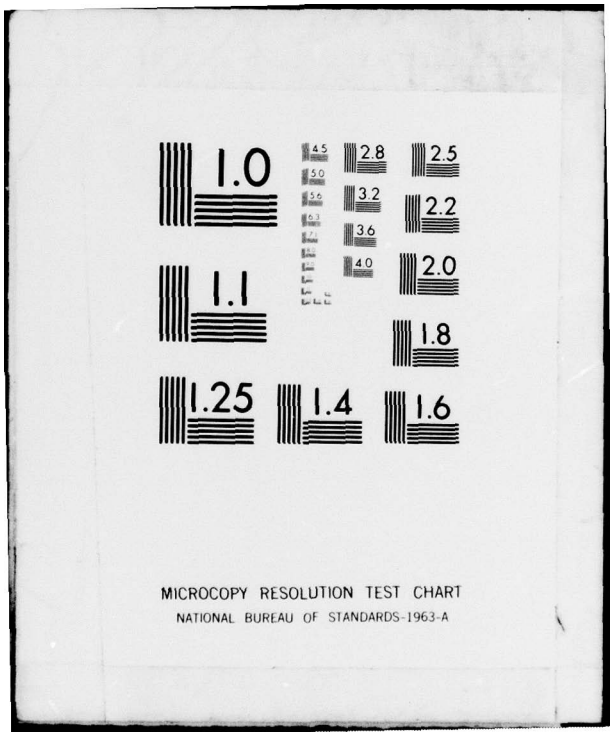
AD-A080 226 AMERICAN ELECTRONIC LABS INC FARMINGDALE NJ F/G 14/2
ELECTROMAGNETIC RADIATION SYSTEM (EMRS) FOR SUSCEPTIBILITY TEST--ETC(U)
APR 79 H V STONE DAAB07-76-C-0332
UNCLASSIFIED CORADCOM-76-0332-9 NL

| OF |
AD
A080226

END
DATE FILMED
3 - 80
DDC


1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
4.5
5.0
5.6
6.3
7.1
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

LEVEL II

12

SC

A076953

RESEARCH AND DEVELOPMENT TECHNICAL REPORT
CORADCOM-

AD A080226

DDC FILE COPY

DDC
RECEIVED
FEB 4 1980
E

This document has been approved for public release and sale; its distribution is unlimited.

CORADCOM
US ARMY COMMUNICATION RESEARCH & DEVELOPMENT COMMAND
FORT MONMOUTH, NEW JERSEY 07703

80 1 28 163

RESEARCH AND DEVELOPMENT TECHNICAL REPORT
CORADCOM- 76-0332-9

ELECTROMAGNETIC RADIATION SYSTEM (EMRS)

FOR SUSCEPTIBILITY TESTING

Margaretta Stone
AMERICAN ELECTRONIC LABORATORIES, INC.
P.O. Box 691
Farmingdale, NJ 07727

APRIL 1979

Quarterly Report for Period: 1 October 1978 - 31 December 1978

Prepared for:

CENCOMS

CORADCOM
US ARMY COMMUNICATION RESEARCH & DEVELOPMENT COMMAND
FORT MONMOUTH, NEW JERSEY 07703

NOTICES

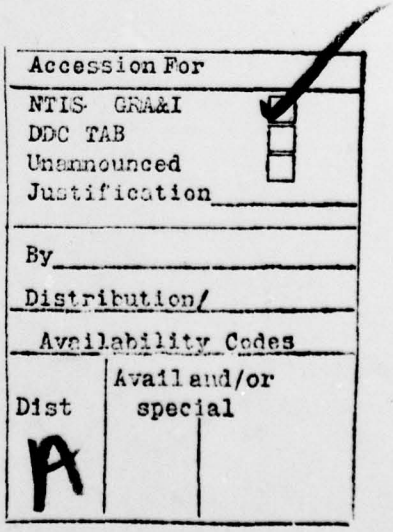
Disclaimers

The findings in this report are not to be construed as an official Department of the Army position, unless so designated by other authorized documents.

The citation of trade names and names of manufacturers in this report is not to be construed as official Government indorsement or approval of commercial products or services referenced herein.

Disposition

Destroy this report when it is no longer needed. Do not return it to the originator.



UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

(19) REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: (18) CORADCOM-76-0332-9

2. GOVT ACCESSION NO.

3. RECIPIENT'S CATALOG NUMBER

4. TITLE (and Subtitle): (6) ELECTROMAGNETIC RADIATION SYSTEM (EMRS) FOR SUSCEPTIBILITY TESTING.

5. TYPE OF REPORT & PERIOD COVERED: (9) Quarterly Report. 1 Oct [illegible] - 1 Dec [illegible]978

6. PERFORMING ORG. REPORT NUMBER

7. AUTHOR(s): (10) Margaretta V./Stone

8. CONTRACT OR GRANT NUMBER(s): (15) DAAB07-76-C-0332

9. PERFORMING ORGANIZATION NAME AND ADDRESS
American Electronic Laboratories, Inc.
P.O. Box 691, Farmingdale, NJ 07727

10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
6.72.01.A
1L7 62701 AH92 C1 071 CB

11. CONTROLLING OFFICE NAME AND ADDRESS
CORADCOM, CENCOMS
DRDCO-COM-RY-3
Fort Monmouth, NJ 07703

12. REPORT DATE: (11) APR [illegible]979

13. NUMBER OF PAGES: (12) 15

14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office): (16) 1L762701AH92 (17) C1

15. SECURITY CLASS. (of this report): UNCLASSIFIED

15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Electromagnetic Compatibility, Electromagnetic Energy
Electromagnetic Radiation System (EMRS)

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The function of the Electromagnetic Radiation System (EMRS) is to generate electromagnetic energy to produce a constant field strength that can be automatically scanned as a function of frequency. The design objective is to cover the frequency range of 30 hertz to 40 gigaherts with field strength intensities up to 200 volts per meter. This report describes system equipment status and results of performance tests in all demonstration frequency ranges (30-60 MHz, 1.0-2.1 GHz, 2.1-4.0 GHz and 12.4-18.0 GHz).

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

411 024

JOB

I. INTRODUCTION

This report describes the activities and developments concerning Phase II of the Electromagnetic Radiation System (EMRS) Program during the period of 1 October 1978 through 31 December 1978. The purpose of Phase II of the EMRS program is to develop the hardware to demonstrate the feasibility of the theoretical design considered in Phase I.

II. STATUS OF EMRS EQUIPMENT

All major equipment comprising the EMRS demonstration system has been received, with the exception of the following:

1. Hewlett-Packard 8495H calibrated attenuator, required to perform measurements in the 12.4-18 GHz range, had to be returned to the manufacturer for repair. Delivery is expected during January 1979.
2. Tunable bandpass filters for the 1 GHz - 2.1 GHz, 2.1 GHz - 4 GHz and 12.4 GHz - 18 GHz frequency ranges have not yet been received. The most recent estimates of delivery are shown below:

   1 GHz - 2.1 GHz Filter: 5 February 1979

   2.1 GHz - 4 GHz Filter: 5 March 1979

   12.4 GHz - 18 GHz Filter: 31 March 1979

III. PROGRESS DURING REPORT PERIOD

During this period, the Logimetrics A200U amplifier, for the 12.4 GHz to 18 GHz range, was repaired by the manufacturer and returned to AEL. It was installed in the system, checked out and found to operate properly.

Tests were performed, in accordance with the EMRS Test Plan dated July 1978, on the 1 GHz - 2.1 GHz, 2.1 GHz - 4 GHz and 12.4 GHz - 18 GHz portions of the system. (The range of 30 MHz to 60 MHz had been tested during the previous quarter.) Results are summarized in Tables 1 through 4, for all four bands.

Table 1 shows that the 30 MHz to 60 MHz EMRS demonstration system met all requirements specified in the test plan for the following tests: Frequency Accuracy, External AM, External FM, High-Level Radiated Output and Level Variation and Non-Radiated Output and Level Variation. It did not meet all requirements for External Pulse Modulation and Low-Level Radiated Output and Level Variation. Tests for Scan Rate and Signal Purity were not performed because they require installation of the 30 MHz to 60 MHz tunable filter.

The 30 MHz to 60 MHz tunable filter was delivered to AEL on 27 December 1978. Its performance is being checked in preparation for its installation in the system.

Table 2 shows that the 1 GHz to 2.1 GHz EMRS demonstration system met all requirements specified in the test plan for the following tests: Frequency Accuracy, External AM, External FM, High-Level Radiated Output and Level Variation and Non-Radiated Output and Level Variation. It did not meet all requirements for External Pulse Modulation and Low-Level Radiated Output and Level Variation. Tests for Scan Rate and Signal Purity were not performed because they require delivery and installation of the 1 GHz to 2.1 GHz tunable filter.

Table 3 shows that the 2.1 GHz to 4.0 GHz EMRS demonstration system met all requirements specified in the test plan for the following tests: Frequency Accuracy, External FM, High-Level Radiated Output and Level Variation and Non-Radiated Output and Level Variation. It did not meet all requirements for External AM, External Pulse Modulation and Low-Level Radiated Output and Level Variation. Tests for Scan Rate and Signal Purity were not performed because they require delivery and installation of the 2.1 GHz to 4.0 GHz tunable filter.

Table 4 shows that the 12.4 GHz to 18 GHz EMRS demonstration system met all requirements specified in the test plan for the following tests: Frequency Accuracy, External AM, External FM, High-Level Radiated Output and Level Variation and Non-Radiated Output and Level Variation. It did not meet all requirements for External Pulse Modulation. The test for Low-Level Radiated Output and Level Variation was not performed because it requires an attenuator now being repaired by the manufacturer. Tests for Scan Rate and Signal Purity were not performed because they require delivery and installation of the 12.4 GHz to 18 GHz tunable filter.

Other work in progress includes a redesign of the external levelling circuit, to perform levelling functions for tuning the filters as well as to maintain the output of the system at a constant level. Work is also in progress to improve the performance of the external pulse modulation circuit.

It was found that the use of an external preamplifier, to increase the level of the sampled radiated signal, is a feasible approach for increasing the dynamic range of the system to lower minimum output. Further research will be done to determine selection of commercial preamplifiers for this purpose.

IV. FUTURE PLANS

During the next reporting period, the following activities are anticipated:

1. Receipt of the repaired attenuator, and performance of the Low-Level Radiated Output and Level Variation test in the 12.4 GHz to 18 GHz range.
2. Completion of redesign work on the external levelling circuit and tests of its performance.
3. Receipt of the 1 GHz to 2.1 GHz filter and performance of Scan Rate and Signal Purity tests in this range.
4. Receipt of the 2.1 GHz to 4 GHz filter and performance of Scan Rate and Signal Purity tests in this range.
5. Installation of the 30 MHz to 60 MHz filter and performance of Scan Rate and Signal Purity tests in this range.

TABLE 1 - SUMMARY OF EMRS TEST RESULTS, 30-60 MHZ FREQUENCY BAND

TEST PLAN PARA.	TEST DESCRIPTION	REQUIREMENT	RESULTS
5.1.2	Frequency Accuracy	Manual: ± 10 MHz Auto: ± 5 MHz	Meets requirements Meets requirements
5.1.3	Scan Rate Limits (Automatic Sweep)	Less than or equal to 5 seconds/octave to more than 100 seconds/octave	Awaiting final installation of filter
5.1.4	External Modulation:		
	AM	0-100%, DC-150 kHz	Meets requirements
	FM	± 20 MHz, DC-100 Hz ± 5 MHz, 100 Hz - 1 MHz ± 2 MHz, 1-2 MHz	Meets requirements
	Pulse, Rise Time	50 nanoseconds	20 nS minimum with internal levelling (See Note 1)
	Pulse, Fall Time	50 nanoseconds	Over 20 nS with internal levelling (Note 1)
	Pulse Width	50 nS - 50 mS	100 nS - 20 mS with internal levelling (Notes 1 and 2)
5.1.5	Radiated Output:		
	High	200 V/M ± 3 dB	Meets requirements
	Low	1 mV/M ± 3 dB	(Note 3)
5.1.6	Non-Radiated Output	10 watts ± 3 dB	Meets requirements
5.1.7	Signal Purity	Harmonics and spurious emission at least 100 dB below fundamental	Awaiting final installation of filter

NOTES:
1. With external levelling, too much overshoot and ringing were found. Levelling circuit is being redesigned.
2. System functions with longer pulses but output level varies if duty cycle exceeds 50%. Meets requirements with lower duty cycle.
3. System dynamic range is 40 dB, for 2 V/M minimum output. Adding external Hewlett-Packard 8447D amplifier to levelling loop adds 26 dB to dynamic range, for a minimum of 100 mV/M.

TABLE 2 - SUMMARY OF EMRS TEST RESULTS, 1-2.1 GHZ FREQUENCY BAND

TEST PLAN PARA.	TEST DESCRIPTION	REQUIREMENT	RESULTS
5.2.2	Frequency Accuracy	Manual: ± 10 MHz Auto: ± 5 MHz	Meets requirements Meets requirements
5.2.3	Scan Rate Limits (Automatic Sweep)	Less than or equal to 5 seconds/octave to more than 100 seconds/octave	Awaiting delivery of filter
5.2.4	External Modulation:		
	AM	0-100%, DC-150 kHz	Meets requirements
	FM	± 75 MHz, DC-100 Hz ± 5 MHz, 100 Hz - 1 MHz ± 2 MHz, 1-2 MHz	Meets requirements
	Pulse, Rise Time	50 nanoseconds	20 nS minimum with internal levelling (See Note 1)
	Pulse, Fall Time	50 nanoseconds	Over 20 nS with internal levelling (Note 1)
	Pulse Width	50 nS - 50 mS	100 nS - 20 mS with internal levelling (Notes 1 and 2)
5.2.5	Radiated Output:		
	High	200 V/M ± 3 dB	Meets requirements
	Low	1 mV/M ± 3 dB	(Note 3)
5.2.6	Non-Radiated Output	+30 dBm ± 3 dB	Meets requirements
5.2.7	Signal Purity	Harmonics and spurious emission at least 100 dB below fundamental	Awaiting delivery of filter

NOTES:
1. With external levelling, too much overshoot and ringing were found. Levelling circuit is being redesigned.
2. System functions with longer pulses, but output level varies if duty cycle exceeds 50%. Meets requirements with lower duty cycle.
3. System dynamic range is 44 dB, for 1.3 V/M minimum output.

TABLE 3 - SUMMARY OF EMRS TEST RESULTS, 2.1-4.0 GHZ FREQUENCY BAND

TEST PLAN PARA.	TEST DESCRIPTION	REQUIREMENT	RESULTS
5.3.2	Frequency Accuracy	Manual: ± 20 MHz Auto: ± 30 MHz	Meets requirements Meets requirements
5.3.3	Scan Rate Limits (Automatic Sweep)	Less than or equal to 5 seconds/octave to more than 100 seconds/octave	Awaiting delivery of filter
5.3.4	External Modulation:		
	AM	0-100%, DC-150 kHz	See Note 1
	FM	± 75 MHz, DC-100 Hz ± 5 MHz, 100 Hz - 1 MHz ± 2 MHz, 1-2 MHz	Meets requirements
	Pulse, Rise Time	50 nanoseconds	20 nS minimum with internal levelling (Note 2)
	Pulse, Fall Time	50 nanoseconds	Over 20 nS with internal levelling (Note 2)
	Pulse Width	50 nS - 50 mS	100 nS - 20 mS with internal levelling (Notes 2 and 3)
5.3.5	Radiated Output:		
	High	200 V/M ± 3 dB	Meets requirements
	Low	1 mV/M ± 3 dB	See Note 4
5.3.6	Non-Radiated Output	+30 dBm ± 3 dB	Meets requirements
5.3.7	Signal Purity	Harmonics and spurious emission at least 100 dB below fundamental	Awaiting delivery of filter

NOTES:
1. Modulation applied directly to generator limited to 60% maximum. Modulation applied to external AM circuitry will go to 100% but distortion is high (many extraneous signals).
2. With external levelling, too much overshoot and ringing were found. Levelling circuit is being redesigned.
3. System functions with longer pulses, but output level varies if duty cycle exceeds 50%. Meets requirements with lower duty cycle.
4. System dynamic range is 40 dB, for 2 V/M minimum output.

TABLE 4 - SUMMARY OF EMRS TEST RESULTS, 12.4 GHZ - 18 GHZ FREQUENCY RANGE

TEST PLAN PARA.	TEST DESCRIPTION	REQUIREMENT	RESULTS
5.4.2	Frequency Accuracy	Manual: ± 50 MHz Auto: ± 70 MHz	Meets requirements Meets requirements
5.4.3	Scan Rate Limits (Automatic Sweep)	Less than or equal to 5 seconds/octave to more than 100 seconds/octave	Awaiting delivery of filter
5.4.4	External Modulation:		
	AM	0-100%, DC-150 kHz	Meets requirements
	FM	± 75 MHz, DC-200 Hz ± 5 MHz, DC-200 kHz	Meets requirements
	Pulse, Rise Time	50 nanoseconds	30 nS with both external and internal levelling
	Pulse, Fall Time	50 nanoseconds	70 nS with external levelling, 4 uS with internal levelling
	Pulse Width	50 nS - 50 mS	100 nS - 10 mS with internal and external levelling
5.4.5	Radiated Output:		
	High	200 V/M ± 3 dB	Meets requirements
	Low	1 mV/M ± 3 dB	Awaiting repair of required attenuator
5.4.6	Non-Radiated Output	+30 dBm ± 3 dB	Meets requirements
5.4.7	Signal Purity	Harmonics and spurious emission at least 100 dB below fundamental	Awaiting delivery of filter

CLEARANCE OF TECHNICAL REPORTS FOR PUBLIC RELEASE

(ECOMR 70-31) SUBMIT IN TRIPLICATE

TO: TDCS Directorate AMSEL-TD-TI	FROM: CORADCOM DRDCO-COM-RY-3 FT Monmouth, NJ 07703	DATE: 3 Apr 79

INSTRUCTIONS: SECTION I: Self explanatory. SECTION IIa: Self explanatory; b, c, d & e: If the report contains any of this information, Distribution Statement B applies (see Appendix II of ECOMR 70-31); f & g: Delete this information from report; h, i & j: Coordinate and obtain approval from agencies concerned. SECTION III: Self explanatory.

In compliance with ECOMR 360-5 and ECOMR 70-31, the attached unclassified technical report is forwarded for clearance for public release and assignment of Distribution Statement A: "Approved for public release; distribution unlimited."

SECTION I DESCRIPTION

1. TITLE OF REPORT Electromagnetic Radiation System (EMRS) for Susceptibility Testing

2. AUTHOR(S) Margaretta Stone EXT NO 201-938-5191

FOR CONTRACT REPORTS

3. CONTRACTING OFFICER'S TECHNICAL REPRESENTATIVE (COTR) EXT NO 201-544-4605

4. CONTRACTOR American Electronic Laboratories, Inc.

5. CONTRACT NO DAAB07-76-C-0332 REPORT NO CORADCOM-76-0332-9

6. CONTRACTOR ☐ IS ☒ IS NOT AUTHORIZED ACCESS TO CLASSIFIED MATERIAL UNDER THIS CONTRACT

SECTION II BASIS FOR RELEASE

The report identified above has been reviewed by the undersigned who affirm that the document does not contain any of the following information:

a. Classified information.
b. Information furnished by a foreign government with the understanding that it not be released outside the U.S. Government.
c. Proprietary information for which authority for release has not been obtained.
d. Information resulting from test or evaluation of commercial products or military hardware.
e. Management reviews, records of contract performance evaluation, or other advisory documents evaluating programs of contractors.
f. Information that would be prejudicial or embarrassing to the Government, a foreign government, a contractor, a corporation or an individual.
g. Information concerning subjects of potential controversy among the military services.
h. Subject matter concerning significant policy within the purview of other agencies outside ECOM.
i. Subject matter that implies official positions or scientific attitudes of higher authority.
j. Subject matter on space, satellite, atomic or CW/BR activities requiring clearance of agencies concerned.

PAUL A. MAJOR _____ AUTHOR (OR COTR)

JOSEPH F. MAHAR _____ DIVISION DIRECTOR

SEL FORM 1100
1 May 71

(Previous editions of this form are obsolete) ESC-FM 610-71

SECTION III CLEARANCE

TO:	FROM:	DATE:
DRDCO-COM-RY-3	DELSD-L-S	10 Apr 79

The report identified in Section I is cleared for public release. It may be made available to the National Technical Information Service. It may also be presented at symposia or published in the open literature in the United States without further clearance, provided no change is made contravening the basis of release certified to in Section II. Notify the Information Officer, ECOM (Ext. 51402) of intention to publish or present.

for Thomas J. O'Brien

WILLIAM R. WERK
CHIEF, STINFO BRANCH

Info Cy: AMSEL-IO

FOLD AND STAPLE

DRDCO-COM-RY-3
Contract DAAB07-76-C-0332
AEL Service Corporation

Date_____

This is to certify that this organization on the above date mailed in the manner indicated in the contract the requisite copies of the 9th quarterly technical report under Contract DAAB07-76-C-0332 to all addresses on the distribution list.

_____
Contractor

BY: _____